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Monitoring the foraging activity of lobsters and associated species by underwater television

by

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Summary

The foraging activity of lobsters (Homarus americanus), crab (Cancer irroratus), flounders (Hippoglossoides platessoides), blue perch (Tautogolabrus adspersus) and cod (Gadus morhua) was observed around a baited lobster traps, by underwater television over a 24 hour period. Preliminary testing of various light sources showed that lobster activity was significantly inhibited by incandescent white and mercury vapour lights. Lobster activity was not significantly affected by red filtered, incandescent or mercury vapor lights. Species specific timing was observed in the patterns of activity. Lobsters were mostly active between 24:00 and 03:00, crab between 01:00 and 04:00, perches between 13:00 and 20:00. Flounders remained present all the time and a single cod fish was caught at night. These patterns of activity may result from diel rhythms in foraging behavior.

Résumé

L'activité de recherche de nourriture des homard (Homarus americanus), crabes (Cancer irroratus), flondres (Hippoglossoides platessoides,) perches bleues (Tautogolabrus adspersus) et de la morue (Gadus morhua) à été observée autour d'un casier à homard appâté, à l'aide d'une caméra de télévision sous-marine pendant une période de 24 heures. Des tests préliminaires effectués sur plusieurs sources de lumière ont montré que l'activité des homards était significativement inhibée par la lumière blanche d'une lampe à incandescence et par celle d'une lampe aux vapeurs de mercure. Par contre l'activité des homards n'était pas significativement affectée lorsqu'un filtre rouge était interposé devant ces sources de lumière artificielle. Des séquences temporelles d'activité propres à chaque espèce ont été observées. Les homards sont surtout actifs entre 24:00 et 03:00 heures, les crabes entre 01:00 et 04:00, les perches entre 13:00 et 20:00. Les flondres ont été présentes durant toute l'expérience et une seule morue a été prise de nuit. Ces séquences temporelles d'activité pourrait être expliquées par des rythmes nycthéméraux de recherche de nourriture.

Many species are attracted by the bait set in lobster traps. In the southern Gulf of St Lawrence, the rock crab, the cod, the blue perch and the eelpout (Macrozoarces americanus) are often caught in lobster traps, The presence of such species in a trap may interfere with catchability of lobsters by preventing them from entering. Rock crabs are an important potential resource for which a small scale industry based on by-catches of the lobster fishery is already developing. A better knowledge of the foraging behavior of the species involved would allow setting traps at the right time of the day and to design them in order to be more selective for a given species (either lobster or crab for instance).

We report hereby our first attempt to develop a system for monitoring the foraging activity of lobsters and associated species in presence of bait in lobster traps by using underwater television.

Material and methods

General set up

The underwater T.V. camera used is a black and white CM-8 Subsea Product with remote focus. The camera used 110 volts AC power provided from the surface through a multiconductor cable. Power is provided by a portable generator. The T.V. camera is monitored from the surface on a video screen and simultaneous recordings can be

made on a ½" VHS video recorder. Complementary information on time is available from an internal clock and appears at request on the video screen. Information can also be output to the screen and video recording from a keyboard.

Two types of lights are available: a mercury vapor one and an incandescent one. The T.V. camera is quite sensitive and will operate in daylight at 20 m depth without any additional light source. Ultra sensitive cameras are available but not easy to operate because they are easily damaged by strong light intensities when taken out of water. Colour cameras do not have as good a resolution as black and white ones and are of little use on the type of sea bed of southern Gulf of St Lawrence due to lack of strong natural colours.

Choice for light type

Since white light was not required by the black and white camera we tested the use of a red filter. Red light disappears from the natural spectrum in the sea within the first few meters and it could be expected that many marine animals including crustaceans would not be very sensitive to red wave lengths.

Sensitivity of lobsters to the two different types of "white" lights and to filtered red lights was tested in an aquarium experiment at Ellerslie Fisheries Station (P.E.I.). Lobsters were set in a tank and monitored using the under water camera under 5 light

conditions: natural light, incandescent white (I.W.) light, Mercury Vapour (M.V.) light, I.W. light with a red filter, M.V. light with a red filter. Plastic pipe shelters were provided for the lobsters. For each light condition, the number of lobsters moving across the field of the camera over 15 successive 2 min. time intervals was used as an activity index. The experiment started at 12:00 hours. The series of activity indices relative to each light condition were compared for significant departure from equal central tendency using a Kruskal Wallis test.

Monitoring in situ activity over a 24 hour cycle

The camera and light was set up on a specially designed stand (Fig. 1) and placed by a diver in front of a standard lobster trap (Fig. 2). The camera faced the "kitchen" of the trap and both entrances of the trap could be monitored. An incandescent light with red filter was used.

The experiment took place on commercial lobster grounds in front of Miminegash over a 24 hour cycle starting at 16:00 hours. The camera was operated from the 44 foot research boat of the Invertebrate Research Section. Salted herring was used as bait.

The activity around the trap was constantly monitored for presence of lobsters, lobsters entering and leaving the trap by the entrance, presence of crabs (Cancer irroratus), blue perch (Tautogolabrus adspersus) flounder (Hippoglossoides platessoides) and cod (Gadus morhua). Direct counts were made and most relevant information was recorded on video tape. The number of individuals

crossing the field of the camera over a half hour time period was used as an activity index.

Results

Testing the different types of light

Activity indices for lobsters kept in the tank under the different conditions of artificial light are presented in Table 1. The Kruskal Wallis test shows highly significant departure from equal central tendencies for the different artificial light conditions ($p=0.001$). Greatest activities took place in decreasing order for incandescent red, then for mercury vapor red then for incandescent white then for mercury vapor.

Sets of observations with indices of activity in natural light, mercury vapor and incandescent red also differ significantly as shown in Table 2. The probability level is 0.004. Greatest activity took place in natural light then in incandescent white, then in mercury vapor.

Sets of observations with indices of activity in natural light, mercury vapor red and incandescent red do not differ significantly (Table 3) although greatest activities were observed in decreasing order for incandescent red, then for natural light then for mercury vapor red.

Activity indices over a 24 hour cycle

Twenty four(24) hour time series of activity indices in standardized unit are presented in Figure 3 for all species monitored except cod. Twenty four (24) hour time series of standard activity indices are presented in Figure 4 for lobsters within the field of the camera, entering and leaving the trap, entering and staying in the trap. Only one cod fish was observed; (it came at night, entered and stayed in the trap).

As a whole, perches were present and very abundant between 13:00 hours and 20:00 hours, and made only one short return at 06:00 hours. Flounders were present all the time, with lowest occurrences between 20:00 hours and 24:00 hours and highest occurrences apparently during day time. Lobsters were present over the 24 hour cycle, but mostly active from 21:00 hours to 04:00 hours with a peak between 24:00 and 03:00 hours, lapse of time during which they entered and either stayed or left the trap through the entrance.

Crabs were sighted mainly between 01:00 and 4:00 in the morning. They also made a short appearance around 13:00 hours.

Discussion

Activity of lobsters appears to be strongly affected by "white" artificial light either incandescent or mercury vapor. It seems to be little affected by red light, particularly incandescent red. This may be due to a range in visible spectrum differing from the human one. Insects, particularly bees, are also known to have a range of visible spectrum different from the human one. Nephrops norvegicus have been observed by one of the authors to react in quite a similar way to lobsters. Incandescent red actually seemed to have less negative effect on activity than natural light, although the difference was not significant. Red light however seems to be seen quite well by fishes.

The different species monitored appear to have well marked diel rhythms of activity. The experiment was conducted however only over 24 hours and there might be at the start some disturbance effect in the environment due to the introduction of the trap and general experimental set up. Longer time series would be required. Crab and lobster peak activities widely overlap although lobsters appear to have been active in this instance 3 hours earlier than crab . It does not seem practical to work out selective catchability for the two species on the basis of differencial setting time for the traps.

The only occurence of cod was during night time, this explains why the fishermen report that cod is often found in traps, is quite

abundant and feeds on small lobsters, although cod was almost never sighted on lobster ground during day time by our divers.

Perch were very active during day time with little if any activity at night. They took apart the salted herring bait in about one hour. Other species started entering only when the perches had left, although only the bones of the herring were left. It would therefore seem best to set the traps at dusk, in order to avoid perches. Tearing apart the bait however might have an attracting effect on other species since small particles are spread around in the current. The succession of scavengers around the bait could also be a natural phenomenon partly independent from diel rhythms. More complete time series of observations will be required in further work.

Table 1. Activity indices for lobsters kept in tanks under different types of artificial light, and resulting statistical tests.

TEST KRUSKAL - WALLIS

Sample 1 15
Sample 2 15
Sample 3 15
Sample 4 15

(Sample sizes)
60

Mercury vapour red light		Incandescent red light		Incandescent light		Mercury vapour light	
SAMPLE NO. : 1		SAMPLE NO. : 2		SAMPLE NO. : 3		SAMPLE NO. : 4	
observ.	rank	observ.	rank	osberv.	rank	observ.	rank
8.00	60.0	2.00	37.5	3.00	49.0	1.00	26.0
4.00	55.0	1.00	26.0	0.00	11.0	0.00	11.0
1.00	26.0	3.00	49.0	1.00	26.0	0.00	11.0
2.00	37.5	3.00	49.0	0.00	11.0	0.00	11.0
4.00	55.0	5.00	58.0	0.00	11.0	0.00	11.0
1.00	26.0	3.00	49.0	0.00	11.0	0.00	11.0
2.00	37.5	2.00	37.5	2.00	37.5	0.00	11.0
0.00	11.0	3.00	49.0	2.00	37.5	0.00	11.0
0.00	11.0	5.00	58.0	1.00	26.0	0.00	11.0
2.00	37.5	3.00	49.0	1.00	26.0	0.00	11.0
5.00	58.0	2.00	37.5	2.00	37.5	2.00	37.5
3.00	49.0	1.00	26.0	0.00	11.0	4.00	55.0
0.00	11.0	0.00	11.0	0.00	11.0	2.00	37.5
2.00	37.5	2.00	37.5	3.00	49.0	2.00	37.5
1.00	26.0	3.00	49.0	0.00	11.0	0.00	11.0
Sum (Ranks)	538.0	Sum (Ranks)	623.0	Sum (Ranks)	365.5	Sum (Ranks)	303.5

H STATISTIC

Number of Tied Groups : 6
Correction Factor
D = .93768
H = 15.39684
DF = 3
ALPHA = .00151

Table 2. Activity indices for lobsters kept in tanks under different types of lighting conditions and the resulting statistical tests.

TEST KRUSKAL - WALLIS

Sample 1 15
Sample 2 15
Sample 3 15

(Samples sizes)
45

Natural light		Mercury vapour light		Incandescent light	
SAMPLE NO. : 1		SAMPLE NO. : 2		SAMPLE NO. : 3	
observ.	rank	observ.	rank	observ.	rank
5.00	44.0	1.00	23.0	3.00	37.5
1.00	23.0	0.00	9.5	0.00	9.5
1.00	23.0	0.00	9.5	1.00	23.0
1.00	23.0	0.00	9.5	0.00	9.5
2.00	32.0	0.00	9.5	0.00	9.5
1.00	23.0	0.00	9.5	0.00	9.5
4.00	40.5	0.00	9.5	2.00	32.0
2.00	32.0	0.00	9.5	2.00	32.0
4.00	40.5	0.00	9.5	1.00	23.0
2.00	32.0	0.00	9.5	1.00	23.0
5.00	44.0	2.00	32.0	2.00	32.0
5.00	44.0	4.00	40.5	0.00	9.5
1.00	23.0	2.00	32.0	0.00	9.5
0.00	9.5	2.00	32.0	3.00	37.5
4.00	40.5	0.00	9.5	0.00	9.5
Sum (Ranks)	474.0	Sum (Ranks)	254.5	Sum (Ranks)	306.5

H STATISTIC

Number of tied groups : 6

Correction factor
D = .91937

H = 11.06137
DF = 2
ALPHA = .00396

Table 3. Activity indices for lobsters kept in tanks under different types of lighting conditions and the resulting statistical tests.

TEST KRUSKAL - WALLIS

Sample 1 15
Sample 2 15
Sample 3 15

(Samples sizes)
45

Natural light		Mercury vapour red light		Incandescent red light	
SAMPLE NO. : 1		SAMPLE NO. : 2		SAMPLE NO. : 3	
observ.	rank	observ.	rank	observ.	rank
5.00	41.5	8.00	45.0	2.00	21.0
1.00	10.5	4.00	36.0	1.00	10.5
1.00	10.5	1.00	10.5	3.00	30.0
1.00	10.5	2.00	21.0	3.00	30.0
2.00	21.0	4.00	36.0	5.00	41.5
1.00	10.5	1.00	10.5	3.00	30.0
4.00	36.0	2.00	21.0	2.00	21.0
2.00	21.0	0.00	3.0	3.00	30.0
4.00	36.0	0.00	3.0	5.00	41.5
2.00	21.0	2.00	21.0	3.00	30.0
5.00	41.5	5.00	41.5	2.00	21.0
5.00	41.5	3.00	30.0	1.00	10.5
1.00	10.5	0.00	3.0	0.00	3.0
0.00	3.0	2.00	21.0	2.00	21.0
4.00	36.0	1.00	10.5	3.00	30.0
Sum (Ranks)	351.0	Sum (Ranks)	313.0	Sum (Ranks)	371.0

H STATISTIC

Number of tied groups : 6

Correction factor
D = .96601

H = .69453
DF = 2
ALPHA = .70663

Fig. 1 - Underwater TV still stand specially designed for monitoring foraging activity around the trap. The camera faces to the right, it is mounted on a mobile horizontal bar which can be positionned at a variable elevation. The camera can be tilted at any angle around the bar.

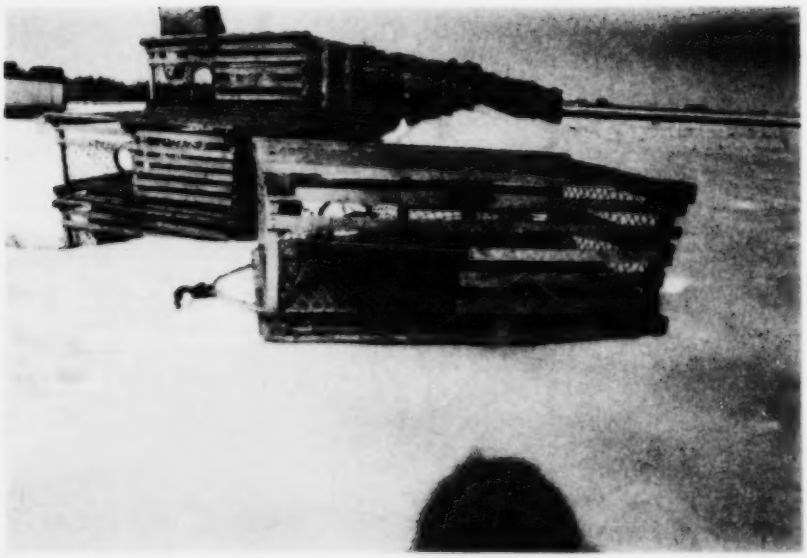

Fig. 2 - Type of parlor lobster trap used for in situ observations.

Figure 3 - Series of 30 minutes observations for activity indices around the trap over a 24 hour cycle.

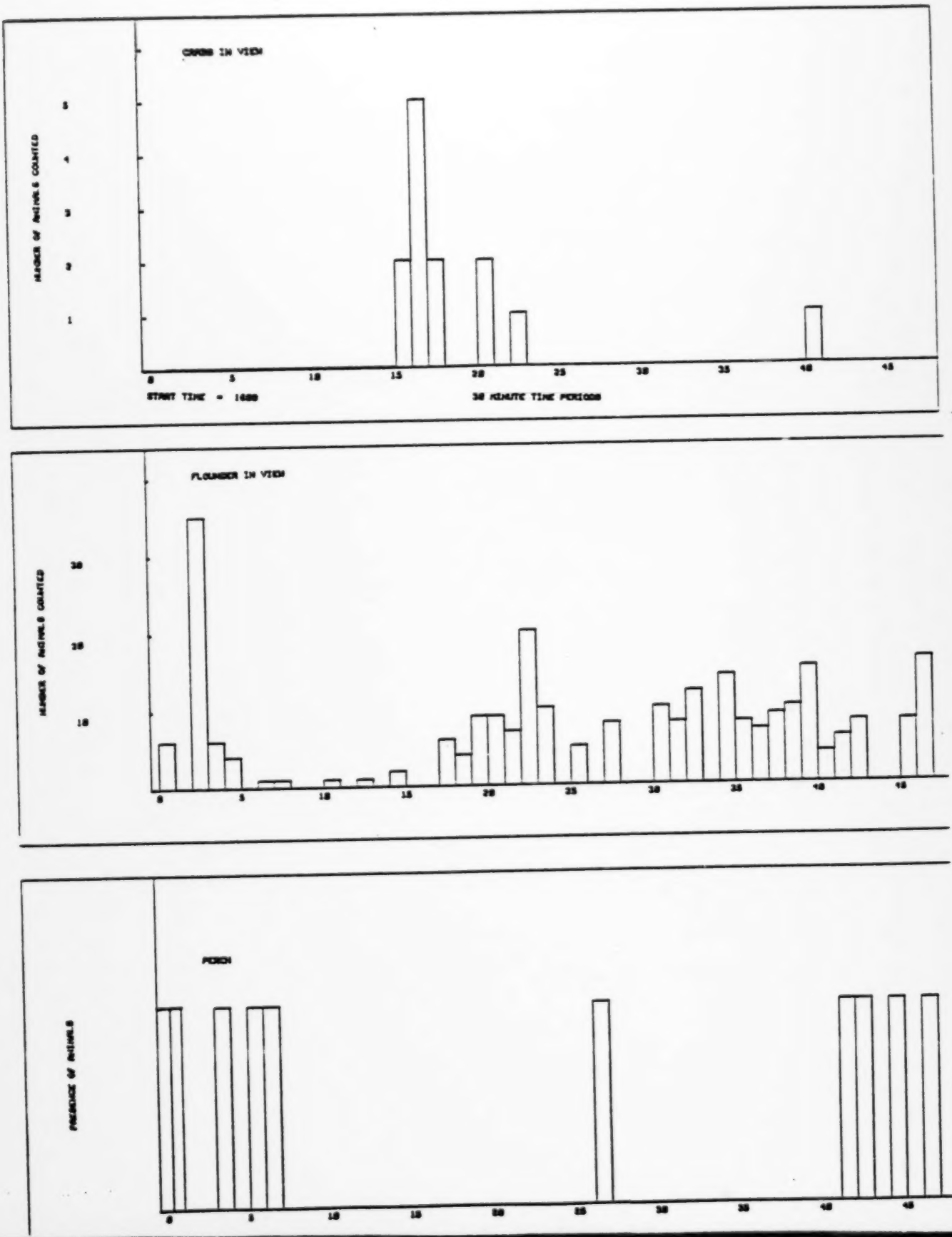

Figure 4 - Series of 30 minutes observations for activity indices around the trap over a 24 hour cycle.